

A Study to Understand the Factors Influencing Telemedicine Utilisation after COVID-19, using the Technology Acceptance Model in Gandhinagar

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Abstract

COVID-19 has been a most extraordinary accelerator in driving global digital transformation. A fundamental objective behind this success has been to increase the reach and connection of public services, particularly those focused on saving lives and livelihoods. Facing the global health crisis, telemedicine (healthcare services delivered through digital means) connected patients and healthcare providers when face-to-face consultations were impossible. Although being an essential component in combating the health crisis during COVID-19, there is little information about patient satisfaction with these treatments. This study has been carried out to investigate the factors influencing the acceptance of telemedicine services among the population of Gandhinagar. The research has developed the Technology Acceptance Model to hypothesise a theoretical framework for explaining user behaviour and attitude towards telemedicine. The responses were looked at using confirmatory factor analysis and structural equation modelling, which showed that factors like voice quality, friendliness of the doctor, perceived usefulness, costs, and perceived ease of use significantly affected people's plans to use telemedicine services.

Keywords: COVID-19, Hypothesise, Technology Acceptance Model, Telemedicine, Theoretical Framework

Introduction

COVID-19 has wreaked havoc on the world, claiming millions of lives, devastatingly affecting public healthcare systems, and causing social and economic instability,

disproportionately hurting the most vulnerable section (V. Haldane et al., 2021).

The COVID-19 pandemic, triggered by SARS-CoV-2 infection, has significantly impacted the world. Healthcare centres have become high-risk transmission places due to the highly contagious nature of this unique virus and a lack of personal protective equipment; healthcare personnel are at high risk of contracting COVID-19.

The devastating impacts of the COVID-19 pandemic have put enormous strain on healthcare systems worldwide. Due to this, health personnel supplies are running scarce. Healthcare staff and resources are being diverted to test and treat those with suspected or confirmed COVID-19 (CDC, 2022). Healthcare facilities have been ultimately endangered to provide better care to COVID-19 patients. Many people are terrified of getting the virus if they go to a hospital.

Telemedicine is proving to be a successful and deep-rooted approach in COVID-19 prevention and treatment during this global pandemic.

The World Health Organization (WHO) has explained telemedicine as "It is a technology by which all healthcare personnel using communication and information technologies deliver the health care services for the exchange of useful information for the examination, treatment, and prevention of diseases and disorders, where distance is the critical factor" (Wooten, 2001). In simple words, it is the exchange of healthcare information to remote places using telecommunications technology.

Telemedicine bridges the gap between healthcare systems, patients, and physicians, allowing everyone,

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mainly asymptomatic patients, to remain at home and communicate with doctors through telecommunication channels, reducing the virus's spread to huge populations and frontline medical professionals (Chellaiyan, Nirupama & Taneja, 2019).

Beyond this, telemedicine is one of the finest possibilities for delivering healthcare services in far and secluded regions. It is more cost-effective and economical to connect isolated and rural areas with a telecommunication system than physically making doctors available at these places. This form of technology not only improves access to treatment, but also has a good influence on the environment by reducing pollution emissions by reducing the need for personnel and patients to travel.

While there is no doubt that telemedicine has a considerable benefit in containing the COVID-19 pandemic, little is known about its long-term prospects. However, there are differing views on whether telehealth will be used post COVID-19. As a result, we investigated the impact of COVID-19 on telehealth acceptability to predict trends in healthcare service utilisation after COVID-19 (Rahi, Khan & Alghizzawi, 2020).

In this study, we aimed to study factors like cost, privacy, perceived risk, and response time, which could affect telemedicine services, using the TAM (Kamal, Shafiq & Kakria, 2020).

Literature Review

The TAM is one of the most influential, tested, and best-operationalised approaches to technology acceptance (Heikoop et al., 2020). According to TAM, a person's main ideas about technology, i.e. (perceived usefulness and perceived ease of use) decide their attitude towards utilising it (Diop, Zhao & van Duy, 2019). Davis, in 1985, proposed that the user's attitude towards the system was a crucial predictor of whether the system would be accepted or rejected. Sometimes, other factors known as external variables (trust, risk, personal comfort) are considered in the TAM (Taherdoost, 2018). The acceptance of telemedicine could be well explained through the TAM.

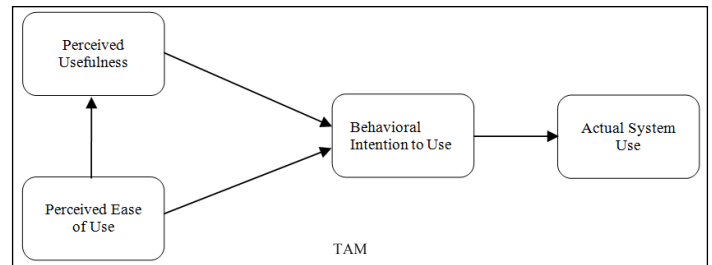


Fig. 1

Telemedicine is a superior alternative to traditional treatment in developed and developing nations; therefore, it is critical to concentrate on the incorporation of some additional social factors (with their primary effect as inhibitors/facilitators) in the TAM and to understand how these factors may affect user's idea about actual system of use. This research study incorporated characteristics such as trust, privacy, risk, response time, cost, and user interface, to acquire a deeper understanding of users' perceptions (Kamal, Shafiq & Kakria, 2020).

Trust

Research has supported the incorporation of risk and trust in medical care technologies over time (McKnight & Chervany, 2014). Trust has long been viewed as a critical factor in determining whether or not new e-health services would be accepted (Anderson & Dedrick, 1990). This is also true for telemedicine services, as patients' acceptance is based on their level of trust (Park et al., 2011). We define faith, in the context of this study, as the perception of people regarding the doctors with whom they are consulting and the medicines they are prescribing on the TM apps.

Risk

Bauer initially proposed perceived risk in research on customer behaviour in 1960. An extended study on consumer perceptions defined perceived risk as a consumer's belief that the product or service they have purchased may not fulfil their demands and expectations.

When a customer utilises an Internet-connected system or completes an online transaction, such as a transaction made using this method, privacy issues, such as personal data breaches, can be a source of concern. Hence, assessing and comprehending the consumer's perceived risk based on perceived danger is essential (Chen et al., 2019).

Personal Comfort

Patient-doctor effective communication is a critical clinical function, and the resulting communication is the core of medicine and an essential constituent in healthcare delivery services (Ha & Longnecker, 2010). Effective communication can only be possible when individuals develop personal comfort, and only then can good healthcare be delivered (Powell et al., 2010). Therefore, assessing personal care has significant importance and affects the usefulness compared to physical visits by the patients.

Cost

As technology progresses, cost savings will become increasingly evident. Telemedicine is a more cost-effective method of healthcare administration in comparison to traditional methods. This is fair since doctors and patients do not need to move from one place to another every time they intend to see a physician or patient. Moreover, online consultations are often less costly than in-person doctor visits, saving us money on travel and hospital arrangements. Additionally, using online booking and video conferencing as part of a healthcare solution saves money.

Response Time

The time the physician takes to respond to any appointment is called the response time. Receiving a meeting with the primary care physician or specialist is often challenging due to the increased rate of lifestyle diseases. The response time provided by telemedicine apps is usually less because patients would not have to wait in extensive lines at clinics for their turn. However, response time guarantees for telemedicine service is pretty challenging.

User Interface

Usability is a critical metric that enables users' experiences and informs the design of mobile health apps. The more straightforward the user interface, the more valuable and simpler it will be. With the increased usage of telemedicine apps, it is essential to measure the apps' usefulness from a user's point of view to ensure better continuity of these telemedicine services.

Quality of the Service

Quality is one such variable that often describes usability. Audio, video, and data are critical key information components in telemedicine applications. Since most healthcare consultations involve verbal communication, verbal instructions, and interactions between the two parties (i.e., the doctor and the patient), quality must be pretty accurate. As the doctors or specialists communicate over the voice link, breaking of the voice should not occur; there should not be any ambiguity in the words spoken because this could lead to loss of important information. Furthermore, the speech quality must be as good as feasible, so traffic must be taken care of.

In the field of telemedicine, video traffic is also crucial. Doctors would have to inspect their patients using remote webcams on one end and consider other essential features, such as the skin colour of patients undergoing skin treatments or the stage of wound in a patient; video cameras of the finest quality must be utilised.

Perceived Usefulness

Perceived utility and perceived ease of use were the most significant predictors of technology acceptance in TAM's early studies. Perceived usefulness is the subjective possibility that using a particular application system will enhance a potential user's work or live presentation (Powell et al., 2010). Patients believe that using telemedicine applications will be beneficial only if it results in speedier delivery of health care at a low cost, improved documentation, medical inspections, and shorter service times of medical care (Kitsiou, Paré & Jaana, 2015). So, through various factors, we can

anticipate that patients will only accept and employ telemedicine services if they believe that doing so would result in better outcomes.

Perceived Ease of Use

The degree to which a capable user accepts the target technology effortlessly can be characterised by perceived ease of use (EOU). This factor is affected by various other external factors, like response time; people do not want to wait long for their turn. Other factors include reduced distance, accessible technology, fewer Internet-related issues, good quality, and so on. If all these factors meet their expectations, people will surely be eager to use telemedicine services (Bonsall & Joint, 1991).

Research Methodology

The study aims to understand the effect of various factors affecting people’s attitudes towards using telemedicine technology. This study also demonstrates the factors that can influence telemedicine use by patients. The ‘Intention to use the telemedicine service’ is dependent on several factors that impact the dependent aspect. The targeted population for the study carried out was Gandhinagar (Gujarat). The sample was collected from 241 respondents through an online survey. The list of different factors affecting telemedicine usage is listed in Table 1.

Table 1: Hypothesis for Different Factors

Factors	Abbreviation	Hypothesis
Voice Quality	VQ	H1: Voice quality influences the intention to use telemedicine services.
Friendliness of Doctor	FD	H2: The friendliness of the doctor influences the intention to use telemedicine services.
Privacy of Data	P	H3: Privacy influences the intention to use telemedicine services.
Perceived Ease of Use	PEU	H4: Perceived ease of use influences the intention to use telemedicine services.
Cost	C	H5: Cost influences the intention to use telemedicine services.

Factors	Abbreviation	Hypothesis
Response Time	RT	H6: Response time influences the intention to use telemedicine services.
Perceived Usefulness	PU	H7: Perceived usefulness influences the intention to use telemedicine services.
Service Time	ST	H8: Service time influences the intention to use telemedicine services.
Trust	T	H9: Trust influences the intention to use telemedicine services.
User Interface	UI	H10: User interface influences the intention to use telemedicine services.

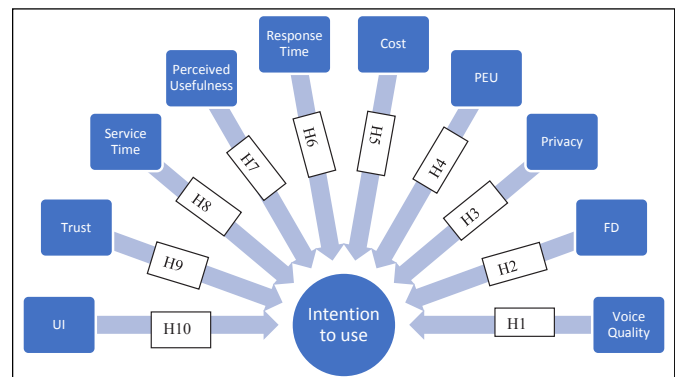


Fig. 2: Schematic Representation of the Hypothetical Model to Determine Factors Influencing Cyberchondria

The questionnaire consisted of two sections; the first part was about the demographic profiles of the participants or respondents, which included information regarding age, sex, income, whether they have Internet access, and payment. The second part of the questionnaire consisted of various factors shown in the chart in Fig. 2. The five-point Likert scale was chosen, which oscillated between strongly disagree (1) and strongly agree (5) (Tullis & Albert, 2013; Bernstein, 2004). Lastly, a question was asked on whether the respondents think telemedicine technology and service have the potential to grow in the future.

Fig. 2 indicates that all of the criteria contributing to whether the telemedicine service has ease of use or usefulness will eventually affect the desire to use the telemedicine service; hence, all of the factors directly or indirectly affect the intention to use telemedicine services.

Data Analysis

The data analysis was done using software like MS Excel, IBM SPSS v23, and IBM AMOS v23. The statistical technique used for the study was SEM (Structural Equation Modelling), to understand the relationship between different factors. The tests for sample adequacy and other correlation values were found using SPSS software.

Results

The data was collected from 241 respondents, and the demographic profiles of the data are given in Table 2. There were around 106 male respondents and 135 female respondents. Good quality Internet required for telemedicine service was available to about 79% of the respondents, and the remaining 21% said that they do not have access to good quality Internet. After this, the education profile of the respondents was addressed in the questionnaire, in which it was found that 127 respondents were graduates, 99 were post-graduates, eight passed high school, and the remaining eight were intermediate-passed students.

Table 2: Demographic Information and Characteristics of Study Participants

Variable	Frequency	Percentage
	Table 2 (Demographics Profile)	
Gender		
Male	106	44%
Female	135	56%
Good Internet Access		
Yes	191	79%
No	50	21%
Qualification		
Graduate	127	52.70%
High School	8	3.32%
Intermediate	7	2.90%
Post-Graduate	99	41.08%

The next step was to understand the internal reliability of data, which was done by finding out the Cronbach's alpha

values evaluated against the standard of 0.7 threshold, which shows that there is an internal consistency of data.

The factors affecting the ease of use in Fig. 2 are shown as EOU, and the factors affecting the usefulness in Fig. 2 are shown as U, followed by subsequent numbers. It was found that seven factors impacted usefulness, represented as U1 = friendliness of the doctor, U2 = privacy of data, U3 = cost, U4 = response time, U5 = usefulness, U6 = service time, and U7 = trust in doctor. In addition, three factors had an impact on the ease of use of telemedicine; those factors are represented as EOU1 = user interface, EOU2 = ease of use, and EOU3 = voice and video quality.

The KMO (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) Bartlett's test was used in IBM SPSS v23 to assess the correlation and factorise the variables before the real factorisation, and the results obtained are shown in Tables 3 and 4.

Table 3: Usefulness Factors

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.931
Bartlett's Test of Sphericity	Approx. Chi-Square	1434.021
	df	21
	Sig.	.000

Table 4: EOU Factors

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.645
Bartlett's Test of Sphericity	Approx. Chi-Square	92.951
	df	3
	Sig.	.000

As can be seen, the KMO value for the factors affecting usefulness is 0.931, which means the sample data is adequate for justifying the hypothesis; the KMO value for EOU factors is 0.645, which is also acceptable, which means that this data is also sufficient to justify the adequacy of the sample data (Kaiser, 1974; Agrawal, n.d.). The correlation matrix was built on understanding the correlation between different factors, which is given in Table 5.

Table 5: Correlation Matrix

Correlation Matrix											
		Voice Quality	Friendliness of Doctor	Privacy	Ease of Use	Cost	Response Time	Usefulness	Service Time	Trust	User Interface
Correlation	Voice and Video Quality	1.000	.743	.683	.715	.616	.669	.681	.246	.155	.198
	Friendliness of Doctor	.743	1.000	.745	.777	.731	.765	.715	.296	.090	.247
	Privacy of Data	.683	.745	1.000	.701	.596	.718	.666	.267	.127	.268
	Ease of Use	.715	.777	.701	1.000	.660	.785	.701	.337	.111	.264
	[Cost]	.616	.731	.596	.660	1.000	.749	.719	.310	.107	.247
	[Response Time]	.669	.765	.718	.785	.749	1.000	.745	.328	.141	.280
	Usefulness	.681	.715	.666	.701	.719	.745	1.000	.339	.251	.268
	Service Time	.246	.296	.267	.337	.310	.328	.339	1.000	.412	.392
	Trust in Doctor	.155	.090	.127	.111	.107	.141	.251	.412	1.000	.321
	User Interface	.198	.247	.268	.264	.247	.280	.268	.392	.321	1.000

The TAM (Model 1) for this study was built using the statistical technique of SEM (Structural Equation Modelling), which shows the different factors affecting the ease of use and usefulness factors, and to what extent they are related.

After performing the tests, the loading numbers were screened on the arrows to check the model fit. For this, statistical values were limited, and CFI (Comparative Fit Index), RMSE (Root Mean Square Error), and TLI (Tucker Lewis Index) values should be around the ideal weight, for the model to be confirmed as the best fit. The desired model was generated, and the statistical values for model fit parameters were checked. The comparative fit index (CFI) is 0.933, Tucker Lewis Index (TLI) is 0.833, and RMSEA 0.059, which signifies that the model has achieved a satisfactory result to be called a model fit. The significant probability level was reached (P = 0.001). After CFA, the SEM model was prepared and run as shown in Fig. 3.

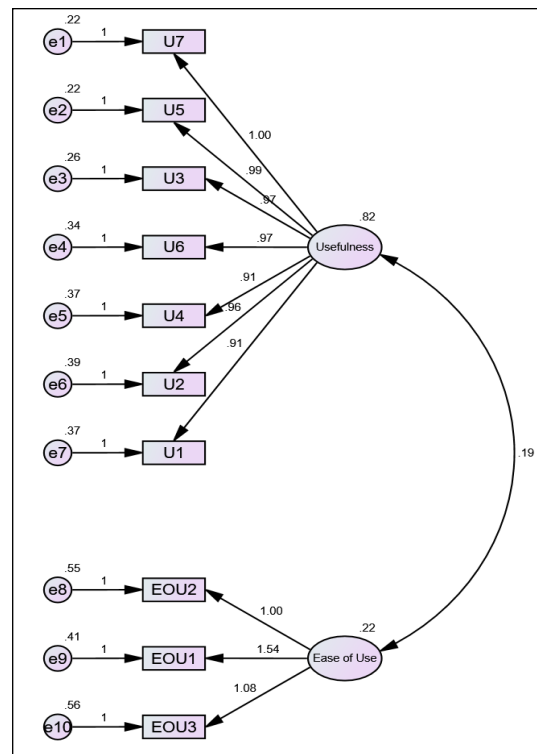


Fig. 3: Amos Diagram Showing Different Factors

Table 6 shows the composite reliability, mean, and standard deviation of the data. It can also be seen that the Cronbach's alpha value of the factors affecting usefulness (U-factors) of telemedicine is 0.944, which means that there is excellent internal reliability in the data. In addition, in the case of factors affecting ease of use (EOU-factors), it is seen that the Cronbach's alpha value is 0.644, which is also acceptable and shows that there is internal reliability in the data.

Table 6: Table showing Estimates of Different Factors (Confirmatory Factor Analysis)

	Estimate	S.E.	C.R.	P	Mean	Std. Deviation	
U7 <--- 1	1.000				3.27	1.019	Cronbach's Alpha = 0.944
U5 <--- 1	.986	.049	20.106	***	3.15	1.011	
U3 <--- 1	.970	.050	19.259	***	3.29	1.015	
U6 <--- 1	.967	.054	17.750	***	3.24	1.052	
U4 <--- 1	.914	.055	16.643	***	3.11	1.029	
U2 <--- 1	.965	.057	16.885	***	3.28	1.077	
U1 <--- 1	.912	.055	16.666	***	3.15	1.026	
EOU2 <--- 2	1.000				3.51	0.881	Cronbach's Alpha = 0.644
EOU1 <--- 2	1.545	.276	5.590	***	3.71	0.966	
EOU3 <--- 2	1.077	.195	5.516	***	3.66	0.903	

TE: $P \leq 0.05$ statistically significant, $***P \leq 0.001$ (Strongly Significant)

Discussions

This research study was developed based on the theoretical model known as TAM (Technology Acceptance Model). The result obtained from AMOS shows that variables have a significant impact on each other with 95% confidence interval, the P value was found to be *******, which is < 0.05 and is therefore enormously significant. So, all the factors are strongly influenced by the respective variables, i.e., perceived usefulness and perceived ease of use.

It can be seen that video and voice quality, friendliness of the doctor, perceived usefulness, cost, response time, service time, and privacy are the most critical drivers for telemedicine usage among the population of Gandhinagar. From this information, we can conclude that people do not want to incur high costs and that they want to get treatment in the shortest time (response time and service time) possible, which means people want quick responses from telemedicine apps.

In the context of a developing country, perceived usefulness and perceived ease of use are significant

factors for telemedicine service acceptability. This finding is consistent with earlier research (Lee, 2009; Rho, Choi & Lee, 2014). Therefore, these factors are essential in the telecare context of Gandhinagar, as has been found elsewhere. People in Gandhinagar believe that the more manageable the telemedicine technology, the more it will be adopted by people there in Gandhinagar. In this way, the least time will be spent by people to attain the benefit of the service.

Voice and video quality are two of the factors which positively influence the Gandhinagar population when accepting any consultation through telemedicine service, which aligns with the previous study's findings (Dinevski, Kelc & Dugonik, 2011). This is because communication with telemedicine services must be done online. Thus, there is no purpose in utilising that service if the voice and video quality are poor. The previous study shows that people are satisfied with the quality.

The friendliness of doctors has also been shown to be an essential factor and positively influences telemedicine usage. It is consistent with the previous studies (Claypool, 2020). If the doctor is friendly over the telemedicine app, it will help the patient be more comfortable with the doctor, and the patient can easily explain all the problems they are facing.

Cost has shown a positive effect on telemedicine usage; this means people in Gandhinagar are concerned about spending huge amounts on telemedicine services. This finding is quite different from the past studies. It is specific to the population of Gandhinagar.

Response time and service time remarkably impact telemedicine usage intention because people want instant response and service from telemedicine services. As the response time and service time of telemedicine applications increase, people do not tend to use the service as these services take a lot of time for consultation. Instead, the patient may opt for in-person consultation from the doctor. Hence, increased response time and service time hurts telemedicine usage.

Perceived usefulness has a very positive effect on telemedicine usage, because if any service is helpful for the patients, they will opt for it. Hence, it is one of the most crucial factors for TM usage, which is also a significant factor in the TAM.

Privacy of data has a significant impact on telemedicine usage. Not only in telemedicine, but in any service, the consumer wants proper privacy of their data. Especially in healthcare records, privacy must be maintained, and so confidentiality plays a vital role in adopting technology. In addition, user interface and trust had a significant impact on telemedicine usage.

Conclusion

Telemedicine services have a great future. Most of the respondents had the same opinion that telemedicine will be beneficial in supporting the country's healthcare system. This study utilised the TAM model to understand the acceptance of this technology by the population of Gandhinagar. This study included many factors that had a direct/indirect effect on telemedicine usage. It was found that the voice quality, friendliness of the doctor, usefulness, cost, response time, service time, privacy, user interface, privacy of data, and ease of use played a significant role in increasing the usage of telemedicine among the population of Gandhinagar. Telemedicine will have a bright future in the upcoming years. Hence, educated people and various institutions should try to promote it, as it will help strengthen the country's healthcare system.

Future Prospects

This study was mainly conducted on the population of Gandhinagar (Gujarat) only, and the data was collected from the patients in Gandhinagar only. Still, this study can be further conducted in different parts of the country. In addition, it can be undertaken for the whole country, to understand the overall scenario of telemedicine in India. Various other factors can be included, which might affect the usage of telemedicine in the country.

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